GE Oil & Gas

21000 Series

Masoneilan* Top Guided Globe Valve with Lo-dB* / Anti-cavitation capabilities Instruction Manual

imagination at work

GE Data Classification : Public

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Safety Information

Important - Please Read Before Installation

The 21000 Series Control Valves instructions contain **DANGER**, **WARNING**, and **CAUTION** labels, where necessary, to alert you to safety related or other important information. Read the instructions carefully **before** installing and maintaining your control valve. **DANGER** and **WARNING** hazards are related to personal injury. **CAUTION** hazards involve equipment or property damage. Operation of damaged equipment can, under certain operational conditions, result in degraded process system performance that can lead to injury or death. Total compliance with all **DANGER**, **WARNING**, and **CAUTION** notices is required for safe operation.

This is the safety alert symbol. It alerts you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in serious injury.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.

CAUTION

When used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, could result in property damage.

Note: Indicates important facts and conditions.

About this Manual

- The information in this manual is subject to change without prior notice.
- The information contained in this manual, in whole or part, shall not be transcribed or copied without 's written permission.
- Please report any errors or questions about the information in this manual to your local supplier.
- These instructions are written specifically for the 21000 Series Control Valves, and do not apply for other valves outside of this product line.

Warranty

Items sold by General Electric are warranted to be free from defects in materials and workmanship for a period of one year from the date of shipment provided said items are used according to GE's recommended usages. GE reserves the right to discontinue manufacture of any product or change product materials, design or specifications without notice.

This instruction manual applies to the 21000 Series Control Valves.

The control valves MUST BE:

- Installed, put into service and maintained by qualified and competent professionals who have undergone suitable training.
- Under certain operating conditions, the use of damaged equipment could cause a degradation of the performance of the system which may lead to personal injury or death.
- Changes to specifications, structure, and components used may not lead to the revision of this manual unless such changes affect the function and performance of the product.
- All surrounding pipe lines must be thoroughly flushed to ensure all entrained debris has been removed from the system.

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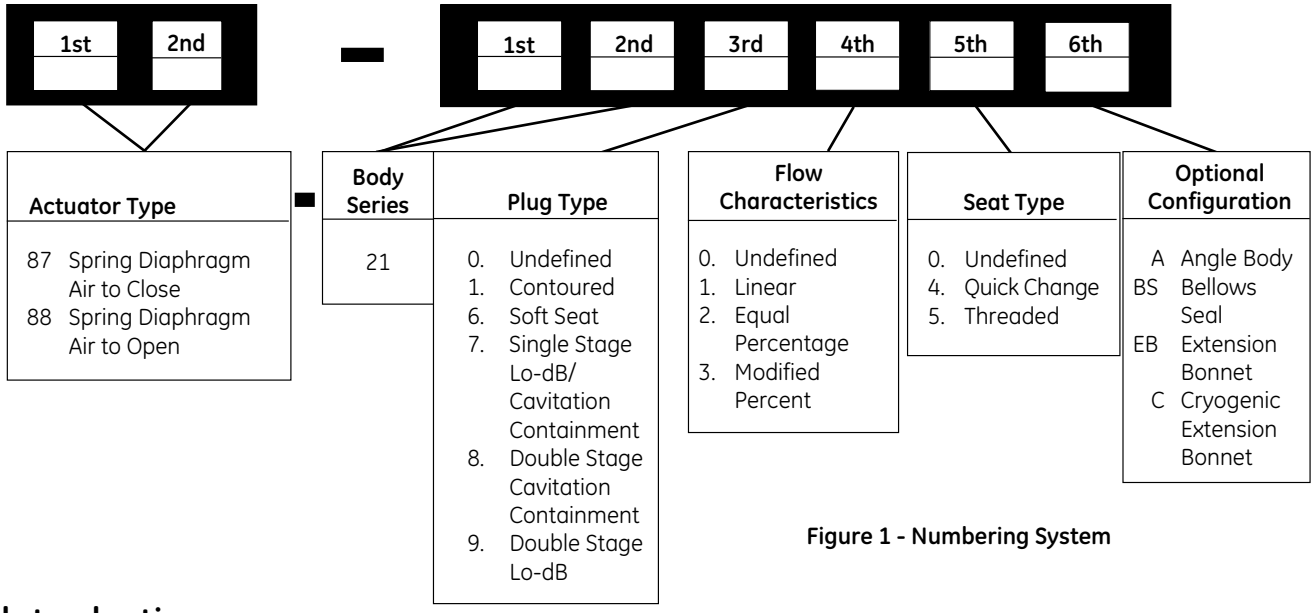

Figure 1 - Numbering System

1. Introduction

The following instructions should be thoroughly reviewed and understood prior to installing, operating or performing maintenance on this equipment. Throughout the text, safety and/or caution notes will appear and must be strictly adhered to, otherwise, serious injury or equipment malfunction could result.

GE has a highly skilled After Sales Department available for start-up, maintenance and repair of our valves and component parts.

Arrangements for this service can be made through your local GE's Masoneilan representative or sales department. When performing maintenance use only Masoneilan replacement parts. Parts are obtainable through your local representative or spare parts department. **When ordering parts, always include Model and Serial Number of the unit being repaired.**

2. General

These installation and maintenance instructions apply to all sizes and ratings of the 21000 Series control valves regardless of the type of trim used.

21000 Series single ported top guided control valves are designed with built in versatility making them well-suited to handle a wide variety of process applications.

Standard construction offers a contoured plug **(21100 Series)** with a threaded seat ring or a quick change seat ring. The heavy top plug guiding provides maximum support to ensure plug stability.

A series of reduced area trim is available to provide wide flow range capabilities in all valve sizes.

Tight Shutoff Class IV leakage is standard. Optional constructions (one of which is the **21600 Series** soft seat plug) meet IEC 534-4 and ANSI/FCI 70.2 Class V and VI requirements.

An optional Low Emission LE® Packing is available to assure compliance with the fugitive emission containment requirements.

Replacing the conventional plug with the single stage Lo-dB design **(21700 Series)** provides excellent noise attenuation or anti-cavitation performance.

The **21800 Series** double stage anti-cavitation valve is derived from the 21700 single stage anti-cavitation valve through a modification to the cage and plug. Substitution of the standard cage with an anti-cavitation cage permits the pressure drop to be split between the two stages efficiently.

The **21900 Series** double stage Lo-dB valve is also derived from the 21700 single stage Lo-dB valve through a modification to the cage and plug. Substitution of the standard cage, with a Lo-dB cage permits the pressure drop to be split between the two stages efficiently.

In the 21800/21900 Series designs, enlargement of the plug head up to the cage diameter permits simultaneous throttling of the plug C_v and the cage C_v. It also provides optimum allocation of the pressure drop between the two stages along the entire plug travel.

Recommended spare parts required for maintenance are listed in the Parts Reference table on page 17. The model number, size, rating and serial number of the valve are shown on the identification tag located on the actuator. Refer to Figure 1 for the 21000 series numbering system.

3. Unpacking

Care must be exercised when unpacking the valve to prevent damage to the accessories and component parts. Should any problems arise, contact your local GE's Masoneilan representative or sales department.

4. Installation

4.1 Before installing the valve in the line, clean piping and valve of all foreign material such as welding chips, scale, oil, grease or dirt. Gasket surfaces should be thoroughly cleaned to ensure leak-proof joints.

4.2 To allow for in-line inspection, maintenance or removal of the valve without service interruption, provide a manually operated stop valve on each side of the 21000 Series valve with a manually operated throttling valve mounted in the by-pass line (See Figure 2).

4.3 The valve must be installed so that the controlled substance will flow through the valve in the direction indicated by the flow arrow located on the body.

- With contoured plug (21100/21600) or Lo-dB plug (21700/21900) :flow-to-open
- On anti-cavitation design (21700/21800) :flow-to-close

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4.4 For heat-insulated installation, *do not insulate the valve bonnet*. Take necessary protective measures relate to personal safety.

5. Air Piping

The actuators are designed to accept 1/4" NPT air supply piping. Use 1/4" OD tubing (4 x 6 mm) or equivalent for all air lines. If the **supply** air line exceeds 25 feet in length (7 meters) or if the valve is equipped with volume boosters, then 3/8" tubing (6 x 8 mm) is preferred. AII connections must be free of leaks.

CAUTION

Do not exceed supply pressure indicated on serial plate located on the yoke of the actuator.

6. Body Disassembly

Access to the internal components of the body should be accomplished with the actuator removed. To remove the actuator from the body, refer to the actuator instruction Ref. GEA19530 for a type 87/88 multispring actuator.

CAUTION

Prior to performing maintenance on the valve, isolate the valve and vent the process pressure. Shut off the supply air line and the pneumatic or electric signal line.

6.1 Threaded Trim (Figure 12 or 14)

After removing the actuator, disassemble the body using the following procedure :

A. If there is a leak detector connection on the lateral NPT port of the bonnet, disconnect this piping as well.

B. Remove body stud nuts (10).

C. Remove bonnet (8), and plug stem (1) and plug (16) sub-assembly together as one unit.

Note: *Spiral wound body gaskets (11) are standard in the 21000 Series design and it is imperative that a new gasket be installed each time the valve is disassembled.*

D. Remove packing flange stud nuts (3), packing flange (4) and packing follower (5).

E. Remove plug (16) and plug stem (1) sub-assembly from the bonnet (8).

CAUTION

Care must be taken to avoid damage to the plug and plug guide.

F. Remove old packing (6) [and optional lantern ring (7) if a leak detection connection has been installed]. Refer to Figure 5.

G. Bonnet (8), plug (16), bushing (12) and seat ring (14) may now be inspected for wear and service damage. After determining the maintenance required, proceed to the appropriate Section of this instruction manual.

6.2 Quick-Change Trim (Figure 13 or 15)

After removing the actuator, disassemble the body using the following procedure:

A. If there is a leak detection connection on the lateral NPT port of the bonnet, disconnect this piping as well.

B. Remove body stud nuts (10).

C. Remove bonnet (8), and plug stem (1) and plug (16) sub-assembly together as one unit.

D. Since the cage (13), seat ring (14) and seat ring gasket (15) are held in place by the bonnet, they may now be removed.

Note: *Spiral wound gaskets (11 & 15) are standard in the 21000 Series design and it is imperative that new gaskets be installed each time the valve is disassembled.*

E. Remove packing flange stud nuts (3), packing flange (4) and packing follower (5).

F. Remove plug (16) and plug stem (1) sub-assembly from the bonnet (8).

CAUTION

Care must be taken to avoid damage to the plug and plug guide.

G. Remove old packing (6) [and optional lantern ring (7) if a leak detection connection has been installed]. Refer to Figure 5.

H. All components may now be inspected for wear and service damage. After determining the maintenance required, proceed to the appropriate Section of this instruction manual.

7. Maintenance & Repair

The purpose of this section is to provide recommended maintenance and repair procedures. These procedures assume the availability of standard shop tools and equipment.

7.1 Threaded Seat Ring Removal (Figure 12 or 14)

Threaded seat rings (14) are installed tightly by the manufacturer, and after years of service they may be difficult to remove.

To facilitate removal, seat ring wrenches can be fabricated to engage the seat ring lugs and adapted to a standard wrench. If the seat ring is exceptionally resistant to removal, the application of heat or penetrating oil should be helpful.

CAUTION

When using heating devices, ensure that proper safety practices are observed. Flammability and toxicity of the process fluid must be considered and proper precautions taken.

7.2 Bushing Removal

The bushing (12) is press fit into the bonnet and does not normally require replacement. If necessary, it may be pulled or machined out. When machining the bushing out, care must be taken to maintain proper dimensions and tolerances in the

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bonnet. These will be furnished upon request.

7.3 Lapping Seats

Lapping is the process of working the valve plug against the seat ring with an abrasive to produce a close fit. If valve leakage is excessive, lapping becomes necessary. The plug and seat ring seating surfaces should be free of large scratches or other defects, and the contact surfaces of the seats should be as narrow as possible. This may require dressing both parts in a lathe. The seating surface angle of the plug is 28 degrees and the seat ring is 30 degrees (relative to the centerline axis). A good grade of fine grinding compound is required for the lapping operation.

The compound should be mixed with a small quantity of lubricant such as graphite. This will slow the cutting rate and prevent tearing of the seating surfaces. The amount of lapping required depends on the materials, condition of seating surfaces, and accuracy of machining. If a short period of lapping does not visibly improve seating, there is usually no advantage in continuing as excessive lapping may result in rough seats. The only remedy is replacement or re-machining of one or both parts. When lapping new plugs and seat rings, begin with a medium fine (240 grit) and finish with a finer grade (600 grit).

Note: *Lapping should produce a line contact area, not the entire surface, due to the difference in seat angles.*

CAUTION

Before lapping, the plug and stem sub-assembly must be concentric. (See pinning operation, section 7.5).

7.3.1 Threaded Trim (Figure 12 or 14)

1. Clean body gasket surface areas.
2. When seat has been removed, ensure that the sealing surface in the body bridge and the threads are thoroughly cleaned.

   Note: *A sealant compatible with the process should be applied* ***sparingly*** *to the seat ring threads and sealing shoulder.*
3. Install and tighten seat ring using fabricated wrench used for removal.

CAUTION

Do not over-tighten. Do not strike seat ring lugs directly. This could distort the seat ring resulting in seat leakage.

4. Apply lapping compound on the plug at several spots equally spaced around the seating area.
5. Insert the stem and plug sub-assembly carefully into the body until it is seated.
6. Place bonnet (8) on the body and fasten the bonnet to the body using four body stud nuts (10) spaced equally apart. Apply slight pressure and tighten evenly.

CAUTION

Do not tighten nuts to final torque specifications at this time. The bonnet is used temporarily for guiding purposes only.

7. Insert two or three pieces of packing (6) into the packing box to assist in guiding the stem and plug during lapping.
8. Screw a drilled and tapped rod with a T-handle onto the plug stem and secure with a locknut (see Figure 4).

   Note: *As an alternative, drill a hole through a flat steel plate and fasten to the plug stem using two locknuts.*
9. Apply slight pressure on the stem, and rotate the stem in short oscillating strokes (around 8 to 10 times). Repeat this step as necessary.

   Note: *The plug should be lifted and turned 90° each time before repeating Step (9). This intermittent lifting is required to keep the plug and seat ring concentric during lapping.*

CAUTION

Avoid over-lapping as this can cause damage to the seating surface rather than improve leakage performance.

10. After completion of the lapping operation, remove bonnet and plug. The seating area of the seat ring and the plug must be cleaned of all lapping compound in preparation for reassembly. **Do not remove seat ring.**

7.3.2 Quick-Change Trim (Figure 13 or 15)

1. Clean body gasket surface areas.
2. Install a new seat ring gasket (15) and insert seat ring (14) in the body.

   Note: *Gasket (15) is temporarily placed to hold the seat ring during lapping.*

   It is imperative to use a new gasket or a test part having the same geometrical characteristics in order to ensure the correct position of the seat ring during lapping.

   This gasket (or similar part) can be kept after lapping for future use.

   The gasket used for lapping must not be reused for the body reassembly.
3. Apply lapping compound at several spots equally spaced around the seating area of the seat ring.
4. Insert the cage (13) into the body.
5. Insert the stem and plug sub-assembly carefully into the body until it is seated.
6. Place bonnet (8) on the body.

CAUTION

Ensure that the seat ring (14), cage (13) and bonnet (8) are properly aligned.

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7. Fasten the bonnet to the body using four body stud nuts (10) spaced equally apart. Apply slight pressure and tighten evenly.

CAUTION

Do not tighten nuts to final torque specifications at this time. The bonnet is used temporarily for guiding purposes only.

8. Insert two or three pieces of packing into the packing box to assist in guiding the stem and plug during lapping.

9. Screw a drilled and tapped rod with a T-handle onto the plug stem and secure with a locknut (see Figure 4).

   Note: *As an alternative, drill a hole through a flat steel plate and fasten to the plug stem using two locknuts.*

10. Apply slight pressure on the stem, and rotate the stem in short oscillating strokes (around 8 to 10 times). Repeat this step as necessary.

    Note: *The plug should be lifted and turned 90° each time before repeating Step (10). This intermittent lifting is required to keep the plug and seat ring concentric during lapping.*

11. After completion of the lapping operation, remove bonnet and internal parts. The seating area of the seat ring and the plug must be cleaned of all lapping compound in preparation for reassembly.

7.4 Lo-dB Plug (Figure 8, 14 or 15)

The procedures used for performing maintenance on a valve equipped with Lo-dB plugs (21700/21800/21900 Series) are the same as those used for Threaded or Quick Change Trim.

CAUTION

Maintenance of the plug should be limited to cleaning of the ports and the procedures defined under Sections 7.3 (Lapping) and 7.5 (Pinning) as required.

7.5 Plug Stem Pinning

Plug stem pinning in the field may be required for the following:

— Replacing existing plug and stem, or

— Replacing existing stem only

Replacing Plug and Stem

If it is necessary to replace the plug, then the plug stem must be replaced at the same time. The original pin hole in an existing stem will not provide the necessary fit, and might seriously impair the strength of the assembly.

A. Reference Marking on the Plug Stem

Measure the depth of the pilot recess in the plug (Dimension X in Figure 9), and make a reference mark on the plug stem at the same distance from the thread.

Note: *While pinning is being performed, care must be taken not to damage the seating surface or plug guide. Always use a soft metal or plastic vice jaws with cylindrical features to hold the plug guide area (see Figure 9).*

B. Screwing Stem to Plug

- Hold the plug (with vise jaw assembly) in a vise.
- Lock two nuts against each other on the end of the new plug stem, and screw the stem ***solidly*** into the plug using a wrench on the upper nut.

When properly assembled, the reference mark (see Section A above) should be flush with the end of the plug guide.

C. Drilling the New Parts

- **If the plug is already fully drilled** (typical for 440 C hardened stainless steel material or solid Stellite or Equivalent), then drill the stem to the same diameter (Diameter C in Figure 9) as the plug shank hole.
- **If the plug guide area has a center mark,**

  PIace the plug guide on a V-block and use a suitable drill size to either:

— Match the hole size in the plug, or

— Match Diameter C (see Figure 9)

Drill through the plug-stem assembly.

- **If the plug guide area does not have any hole or any center mark,**

— Measure Dimension D based on the plug guide diameter and stem diameter (see Figure 9).

— PIace the plug guide on a V-block, and make a center mark on the plug guide area using a center punch.

— Drill through the plug-stem assembly using a suitable size drill bit.

In all cases after drilling: Remove any burrs from the plug guide hole by making a slight chamfer.

D. Pinning the Plug-Stem Assembly

1. Select the correct size pin based on the plug guide diameter and stem diameter (see Figure 9). Apply a small amount of grease on the pin and hand assemble it into the hole in the plug.
2. Press fit the pin into the hole using a hammer. Complete the pinning operation by taking care to ensure that the pin is recessed by the same amount at both sides (see Figure 9).
3. After the plug has been pinned, it should be placed in a lathe to ensure it is concentric with the stem.

   If the assembly is not running true, then the stem should be placed in a collet with the plug guide against it and the plug should be adjusted. Alignment of plug stem can be performed by means of a soft faced mallet.

Replacing Existing Stem Only

A. Removing Existing Pin and Stem

1. Place the plug guide on a V-block and use a drift punch to drive out the old pin.

   Note: *If it is necessary to drill out the pin, use a drill bit slightly smaller than the pin diameter.*

2. Hold the plug guide in a vise (see note on opposite side of page).
3. Lock one nut against another at the end of the plug stem.

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Using a wrench on the lower nut, unscrew the stem from the plug. The stem is removed by turning it counter-clockwise.

B. Screwing Stem to Plug

Refer to step B of the previous section on "REPLACING PLUG AND STEM".

C. Drilling the New Stem

PIace the plug guide on a V-block and use a suitable size drill bit to drill the stem (use the hole in the plug as a guide).

Note: *If the hole in the plug guide has been slightly damaged while removing the old pin, choose a drill bit and a pin with a slightly larger diameter than the normal pin.*

D. Pinning

Select the correct size pin based on the plug guide diameter and pin hole diameter. Proceed as described in part D of the previous section, taking care not to damage the plug guide area.

Ensure plug stem alignment following the pinning operation.

7.6 Packing Box (Figures 12 to 15)

Packing box maintenance is one of the principle action items of routine servicing. Tightness of the packing is maintained by packing compression. Compression is achieved by evenly tightening the packing flange nuts (3) against the packing flange (4). Care must be taken not to over tighten as this could prevent smooth operation of the valve. If all compression is used up and the valve leaks, then new packing is required.

CAUTION

Valve must be isolated and the pressure vented before performing packing box maintenance.

Proceed as follows :

7.6.1 Braided PTFE with Carbon or Aramid Core (Standard) (Figures 12 to 15)

Note: *The Braided PTFE/Carbon or Aramid packing rings have a skive cut allowing packing replacement without disconnecting the plug stem from the actuator connector or actuator stem.*

A. Loosen and remove packing flange nuts (3).

B. Lift the packing flange (4) and packing follower (5) up the valve stem.

Note: *They may be taped in place to keep them out of the way before proceeding.*

C. By means of a hooked instrument, remove packing (6) ensuring not to damage the sealing surfaces of the packing box or plug stem.

Note: *On valves equipped with an optional lubricator connection, the lantern ring (7) must also be removed to gain access to lower packing rings.*

D. Replace packing rings (6).

Note: *Assemble and compress rings one at a time into packing box. The skive cut of each packing ring must be placed about 120 degrees apart.*

Note: *On valves equipped with an optional lubricator connection, refer to Figure 10 for correct amount of rings to place under the lantern ring (7).*

E. Replace packing follower (5) and packing flange (4).

F. Replace and tighten packing stud nuts (3).

CAUTION

Do not overtighten.

G. Place valve back in service and only tighten packing as necessary to stop external leakage.

Note: *In an emergency, string packing may be used as a temporary repair only. It must be replaced with the correct packing as soon as possible.*

7.6.2 Flexible Graphite Rings (Optional - See Figure 6)

Note: *Flexible graphite packing rings replacement may require disconnecting the plug stem from the actuator stem and removal of the actuator if rings are not skive cut.*

A. Remove actuator from the body S/A. Refer to actuator instruction Ref. GEA19530 for a type 87/88 actuator.

B. Loosen and remove packing flange nuts (3).

C. Remove packing flange (4) and packing follower (5) from the plug stem.

D. By means of a hooked instrument, remove packing (6) ensuring not to damage the sealing surfaces of the packing box or plug stem.

Note: *On valves equipped with an optional lubricator connection, the lantern ring (7) must also be removed to gain access to lower packing rings.*

E. Replace new packing set (6); first assemble a back-up ring *(Graphite Filament Yarn braided ring),* then the flexible graphite rings *(smooth rings),* and finally another braided back-up ring (refer to Figure 6).

Note: *Assemble and compress rings one at a time into packing box.*

Note: *On valves equipped with an optional lubricator connection, refer to Figure 10 for correct arrangement according to valve size.*

F. Assemble packing follower (5) and packing flange (4).

G. Assemble and tighten packing stud nuts (3).

CAUTION

Do not overtighten.

H. Proceed to appropriate instructions for actuator and valve assembly adjustment.

I. Place valve back in service and only tighten packing as necessary to stop external leakage.

7.6.3 LE* Packing (Optional - See Figure 7)

The Masoneilan LE (Low Emissions) Packing from GE is a high performance packing system capable of containing fugitive emissions well below the specifications of the most severe recommendations. It is also available in a firesafe configuration.

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The packing is provided as a set of five pieces. It consists of two adapter rings and three V-rings. An alternating pattern of Perfluoroelastomer (PFE) and long carbon fiber filled Teflon (PTFE) V-rings are used.

Applied properly, this packing exhibits very little cold flow (or creep). Consequently, it can effectively prevent fugitive emissions leaks from a control valve. The LE Packing system can directly replace conventional packing, requiring no modification to the control valve or actuator.

A spring loaded, two-piece follower assembly is used to maintain a constant load on the packing, and is necessary for thermal cycling applications. As the definition of thermal cycling can vary, and processes are potentially subject to unpredicted thermal gradients, LE Packing is only available with the spring loaded follower.

Installation should be performed as detailed in the following paragraphs.

7.6.3.1 Preparation

7.6.3.1.1 Stem

Inspect stem for any nicks or scratches on the surface finish. Reject the stem for any of these reasons as they may damage packing.

Note: *A properly etched part number on the stem in the packing area will have no adverse effect on the performance of the packing.*

Stem finish should be 3-7 AARH (Ra 0,1/0,2).

7.6.3.1.2 Packing Box

Note: *Bonnets that have a lube hole or leak detection port are unacceptable for use with the packing arrangement shown in Figure 7.*

CAUTION

Packing box should be clean and free of burrs, rust, and any foreign matter. Parts can be cleaned with denatured alcohol.

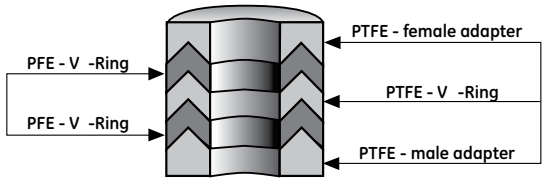
Note: *Packing box finish should be 125 AARH (Ra 3,2) or better.*

The packing box may be bored or honed oversize by up to 0.015" (0.38 mm) above the nominal diameter to improve the finish. For instance, a nominal 0.875" (22.22 mm) packing box may be bored or honed up to 0.890" (22.60 mm) and the LE Packing will still seal properly.

Packing box must be finished to the bottom of the bore.

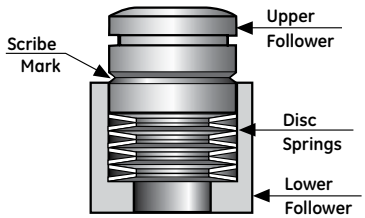
7.6.3.1.3 Packing

Inspect packing rings. **Do not** use packing if any nicks or scratches on packing are observed. Check packing and ensure that it is in the proper arrangement (see Figure below). PFE material can be identified by the gloss black molded finish. PTFE material has a dull black machined finish.



7.6.3.1.4 Spring Loaded Follower

The spring loaded follower consists of an upper and lower follower and eight (8) disc springs (see Figure below). The springs are installed inside the lower follower and positioned alternately. The assembly is held together by tape, which must be removed before installation.



7.6.3.2 Packing Installation

a. The packing must be lubricated with Krytox ® fluorinated grease prior to installation (Krytox GPL206 or equivalent).

b. Packing should be lubricated as a set (**not individually**) to minimize getting lubricant between the rings.

c. Packing should be lubricated with a generous application to the O.D. and I.D. of the packing set.

Note: *All exposed surfaces of the packing set must be covered with the lubricant*.

d. PFE/PTFE is to be installed as a set. Carefully slide the packing set down the stem. Do not cock or force the packing on the threads.

If the packing set separates while on the stem, do not remove. Continue installing the remaining pieces to put the set back together.

e. Gently press the packing into the packing box. Do not tap the packing down into the box.

f. The spring loaded follower is installed on top of the packing. This follower is installed as an assembly held together by tape. This tape should be removed after assembly. Proper assembly of the packing box will leave the top of the Lower Follower 0.25 - 0.50 inches (6 to 13 mm) above the bonnet.

A groove is scribed into the O.D. of the upper follower. The packing flange is tightened evenly until the top of the Lower Follower aligns with the scribe mark (groove) in the Upper Follower.

Note: *This is the optimum loading for this packing. Further tightening will shorten life of the packing. Thread locking compound can be used on packing nuts.*

g. The packing should be checked for leakage.

h. Packing load should be checked after the valve has

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cycled approximately 500 times. Adjust if necessary. No further adjustment should be required for the life of the packing.

7.7 Soft Seat Plug (Figure 3)

The soft seat plug used in the 21000 Series valve has a replaceable insert. To remove and replace the insert, proceed as follows.

CAUTION

The shank OD is the plug guide. Extreme care must be taken to prevent scoring or marring this surface. Failure to do so could result in damage to the guide bushing and destruction of the plug. Two flats are provided for holding.

A. Loosen set screw until the head of the set screw is flush with the OD of the shank.

Note: *On 3/4"- 2" size valves, the plug tip has a machined slot into which a bar can be inserted for removal. On 3"- 6" size valves, the plug tip has two machined holes into which a tool (fabricated with appropriate size pins) can be inserted for removal.*

B. Carefully place plug sub-assembly into a soft jaw vise, holding the plug by the flats provided on the upper end of the shank.

CAUTION

When using a vise to hold the plug, extreme care must be taken not to damage the plug shank.

C. Using the appropriate tool, unscrew plug tip (counter-clockwise) from the shank sub - assembly.

D. Remove insert O-ring (for valve sizes 3"- 8" only) and insert retainer. Discard existing insert and O-ring.

E. Thoroughly clean all remaining metallic components and install new insert and O-ring as follows (according to valve size):

For 3/4"- 2" valves :

a. Place new insert on shank and insert retainer as shown in Figure 3.

b. Install plug tip into shank sub-assembly. Hand tighten and ensure plug tip seats evenly against insert.

For 3" - 8" valves:

a. Apply a light coat of lubricant to the O-ring and install on insert retainer.

CAUTION

Ensure any lubricant used is compatible with service conditions.

b. Install new insert on insert retainer and assemble as shown in Figure 3.

c. Install plug tip into insert retainer sub-assembly insuring the plug tip seats evenly on the insert.

F. Carefully place the plug sub-assembly into a soft jaw vise, holding the plug by the flats provided on the upper end of the shank.

CAUTION

When using a vise to hold the plug, extreme care must be taken not to damage the plug shank.

G. Using the appropriate tool used during disassembly, firmly tighten the plug tip.

CAUTION

The plug tip must be tightened, allowed to set for approximately 4 hours, re-tightened, allowed to set another 4 hours, then tightened one more time. The purpose of this tightening sequence is to allow the insert material to "cold flow" into place on the plug sub-assembly.

H. Following the above tightening sequence, securely tighten the set screw down into the plug. Plug is ready for assembly into the valve.

8. Valve Body Reassembly

After completion of the required maintenance, the valve should be reassembled using the following procedures:

Note: *If any of the following steps were completed during maintenance, then proceed to the next step.*

8.1 Threaded Trim (Figure 12 or 14)

A. Clean all gasket mating surfaces.

B. Apply a small amount of sealant to the seat ring threads and sealing shoulder. Install seat ring into valve body.

Note: *A sealant compatible with the process should be applied sparingly.*

C. Install and tighten seat ring using wrench used for removal.

CAUTION

Do not over-tighten. Do not strike seat ring lugs directly. This could distort the seat ring resulting in unwarranted seat leakage.

D. Carefully install plug and stem assembly.

Note: *Valve should be lapped before final assembly. See Section 7.3.*

E. Install body gasket (11).

Note: *Spiral wound body gaskets (11) are standard in the 21000 Series design. It is imperative that a new gasket be installed each time the valve is disassembled.*

F. Assemble bonnet (8) and body stud nuts (10). Bonnet must be positioned so the packing flange studs are at 90° to the flow center line.

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CAUTION

Tighten nuts (10) until metal to metal contact is obtained with proper bolt torque. Refer to Figure 11 for proper bolt torque and tightening sequence specifications.

G. Insert packing (6) *[and lantern ring (7) on valve equipped with an optional lubricator connection]*. Refer to Section 7.6 for proper packing assembly procedure for standard or optional designs.

H. Install packing follower (5) and packing flange (4).

I. Install packing flange stud nuts (3).

CAUTION

Do not overtighten (See Section "7.6. Packing Box").

J. If a leak detection connection was installed, connect it on the lateral NPT port in the bonnet. If not, ensure that the 1/4" NPT plug remained in place (Figure 5).

K. For actuator assembly and plug stem adjustment, proceed to the actuator instruction Ref. GEA19530 for a type 87/88 actuator.

8.2 Quick-Change Trim (Figure 13 or 15)

A. Clean all gasket mating surfaces.

B. Install seat ring gasket (15) and seat ring (14).

Note: *Spiral wound gaskets (11 & 15) are standard in the 21000 Series design. It is imperative that a new gasket be installed each time the valve is disassembled.*

C. Install cage (13).

D. Carefully install plug and stem assembly.

Note: *Valve should be lapped before final assembly. See Section 7.3.*

Note: *For 2" valves with C_v 30 Lo-dB / Anti-Cavitation trim only, steps C and D must be reversed such that the plug and stem assembly is installed prior to the cage.*

E. Install body gasket (11).

F. Assemble bonnet (8) and body stud nuts (10) and tighten. Bonnet must be positioned so the packing flange studs are at 90° to the flow center line.

CAUTION

Care must be taken to ensure that the cage, seat, and bonnet are properly aligned in the body. Cage should be installed with parts at lower end, near seat ring. Tighten nuts (10) until metal to metal contact is obtained with proper bolt torque. Refer to Figure 11 for proper bolt torque and tightening sequence specifications.

G. Insert packing (6) *[and lantern ring (7) on valve equipped with an optional lubricator or leak detection connection]*. Refer to Section 7.6 for proper packing assembly procedure for standard or optional designs.

H. Install packing follower (5) and packing flange (4).

I. Install packing flange stud nuts (3).

CAUTION

Do not overtighten (See Section "7.6. Packing Box").

J. If a leak detection connection was installed, connect it on the lateral NPT port in the bonnet. If not, ensure that the 1/4" NPT plug remained in place (Figure 5).

K. For actuator assembly and plug stem adjustment, proceed to the actuator instruction Ref. GEA19530 for a type 87/88 multispring actuator.

8.3 High Pressure & Angle Design (Figures 16 & 17)

Standard trim is used within these optional body configurations. Refer to the applicable sections within this instructions manual.

9. Actuators

9.1 Types 87/88 Actuators

Refer to Instruction Ref. GEA19530 for removal, maintenance, assembly and adjustment.

10.Bellows Seal Assembly

CAUTION

SINCE THIS IS A SEALING BELLOWS, THE PLUG STEM SHOULD NEVER BE TURNED UNDER ANY CIRCUMSTANCES.

There is a built-in anti-rotation feature, consisting of a double flat surface machined on the plug stem that slides into a rectangular slot machined in the upper bushing (30) of the bellows (see Figure 19 - Section a).

IT IS IMPORTANT TO DISCONNECT THE ACTUATOR FROM THE VALVE BEFORE CHANGING THE ACTUATOR ROTATIONAL POSITION.

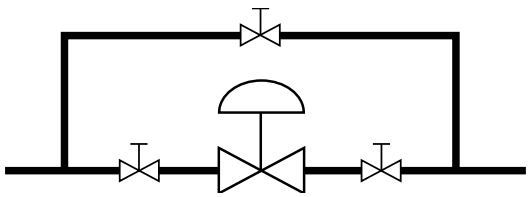

Figure 2 - Typical Installation

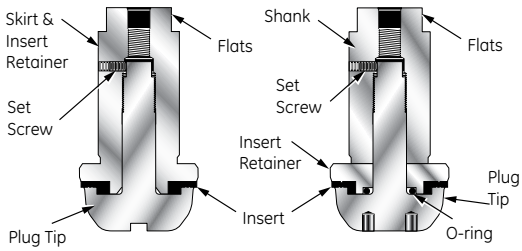

Figure 3 - Soft Seat Plugs (Optional)

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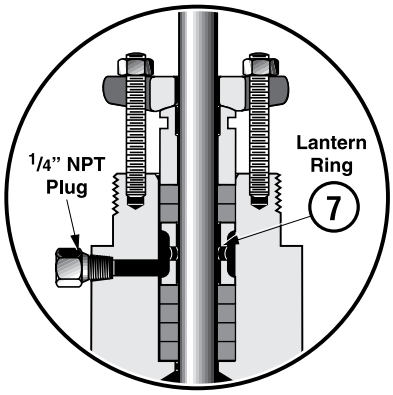

Figure 5 - Lubricator Connection (Optional)

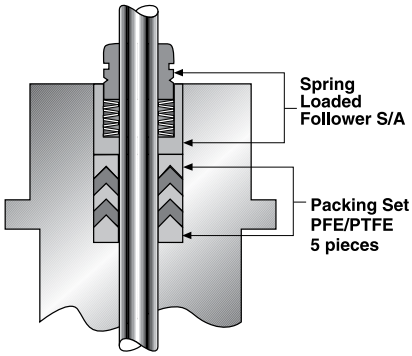

Figure 7
LE® (Low Emission) Packing Arrangement (Optional)

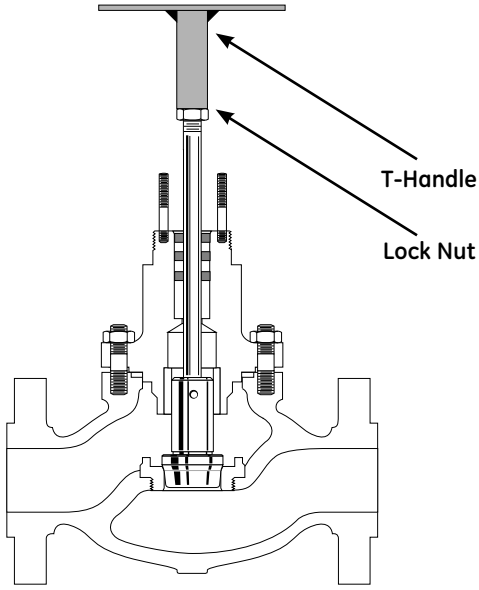

Figure 4 - Seat Lapping Device

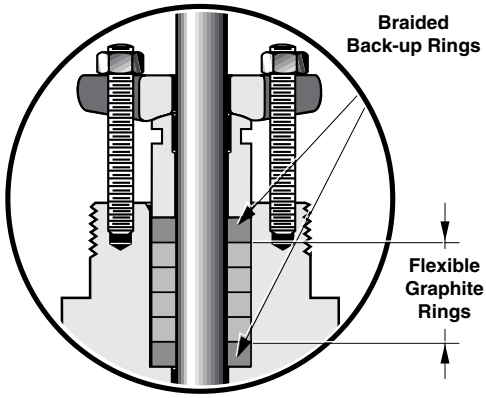

Figure 6 - Flexible Graphite Rings Arrangement (Optional)

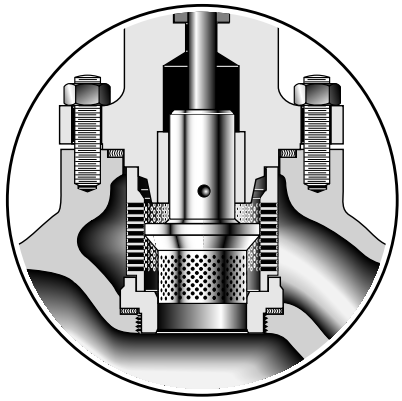

Figure 8
Lo-dB (Type 21900) and Anti-cavitation (Type 21800) Double Stage Trim (Optional)

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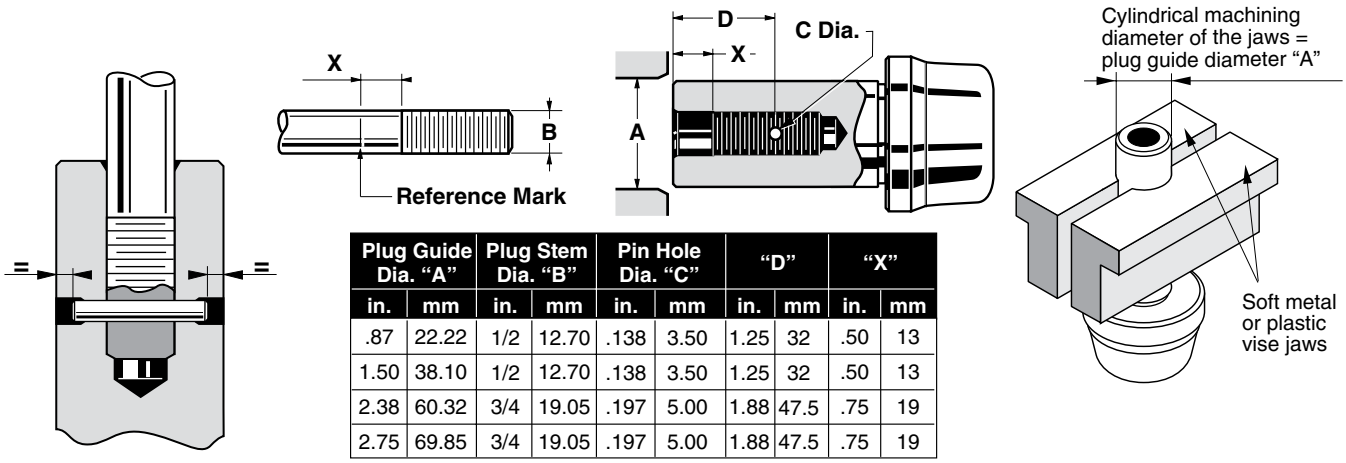
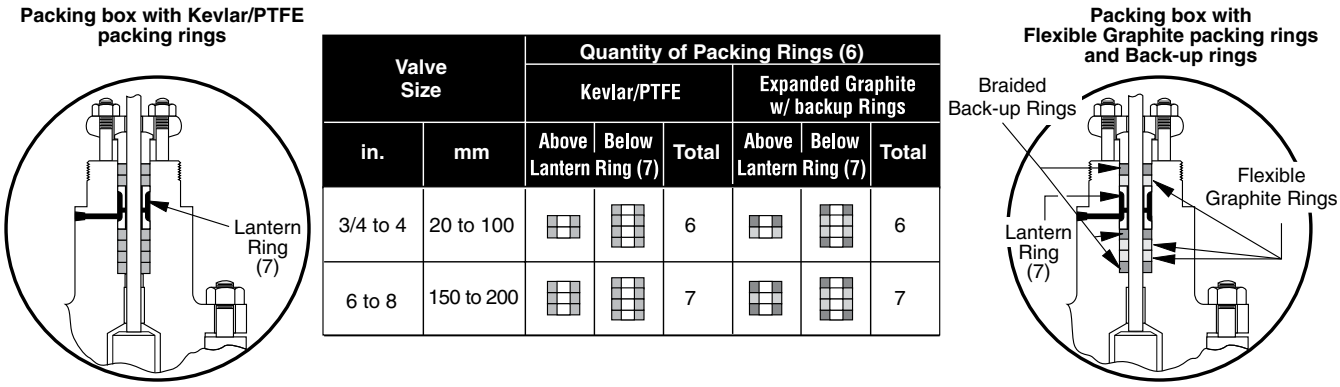


Plug Guide Dia. "A"		Plug Stem Dia. "B"		Pin Hole Dia. "C"		"D"		"X"	
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
.87	22.22	1/2	12.70	.138	3.50	1.25	32	.50	13
1.50	38.10	1/2	12.70	.138	3.50	1.25	32	.50	13
2.38	60.32	3/4	19.05	.197	5.00	1.88	47.5	.75	19
2.75	69.85	3/4	19.05	.197	5.00	1.88	47.5	.75	19

Figure 9 - Plug Stem Pinning


Packing box with Kevlar/PTFE packing rings
Lantern Ring (7)
Packing box with Flexible Graphite packing rings and Back-up rings
Braided Back-up Rings
Flexible Graphite Rings
Lantern Ring (7)

Valve Size		Quantity of Packing Rings (6)					
		Kevlar/PTFE			Expanded Graphite w/ backup Rings		
in.	mm	Above Lantern Ring (7)	Below Lantern Ring (7)	Total	Above Lantern Ring (7)	Below Lantern Ring (7)	Total
3/4 to 4	20 to 100			6			6
6 to 8	150 to 200			7			7

Figure 10 - Packing Ring Arrangements with Optional Lubricator Connection

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Assembly Torque Requirements

Valve Size		ANSI Class	Bolting Requirements		Torque Requirements					
					Minimum		Maximum		Pre-Load	
inch	mm		Qty.	Size (inch)	Lbs.Ft	N.m	Lbs.Ft	N.m	Lbs.Ft	N.m
.75 & 1	20 & 25	150 & 300	4	1/2"-13NC-2A	25	34	66	89	5	7
		600	4	1/2"-13NC-2A	25	34	66	89	5	7
		900 & 1500	4	1"-8NC-2A	125	169	560	759	45	61
		2500	4	1"-8NC-2A	125	169	560	759	45	61
1.5 & 2	40 & 50	150 & 300	8	1/2"-13NC-2A	25	34	66	89	5	7
		600	8	1/2"-13NC-2A	25	34	66	89	5	7
		900 & 1500	8	7/8"-9NC-2A	100	136	300	407	30	41
1.5	40	2500	8	7/8"-9NC-2A	100	136	300	407	30	41
2	50	2500	8	1-1/8"-7NC-2A	160	217	640	868	60	81
3	80	150 & 300	6	5/8"-11NC-2A	45	61	132	179	10	14
		600	8	3/4"-10NC-2A	80	108	230	312	20	27
		900 & 1500	8	1-1/8"-8NC-2A	225	305	830	1125	75	102
4	100	150 & 300	8	5/8"-11NC-2A	45	61	132	179	10	14
		600	8	1"-8NC-2A	125	169	560	759	45	61
		900 & 1500	8	1-1/2"-8NC-2A	400	542	2100	2847	115	156
6	150	150 & 300	12	5/8"-11NC-2A	45	61	132	179	10	14
		600	12	1"-8NC-2A	125	169	560	759	45	61
8	200	150 - 600	12	1-1/4"-8NC-2A	235	319	1200	1627	100	136

Notes: 1. Do not exceed Maximum Torque values listed.
2. Tighten in increments until required torque levels are reached.
3. Reject assembly if metal-to-metal contact is not achieved after reaching Maximum Torque.
4. Torque requirements shown are for standard B7 studs and 2H nuts.

Bellows Bonnet Assembly Torque Requirements

Bolting Requirements		Torque Requirements							
		Minimum		Maximum		Increments		Pre-Load	
Qty.	Size (inch)	Lbs.Ft	N.m	Lbs.Ft	N.m	Lbs.Ft	N.m	Lbs.Ft	N.m
8	1/2"-13NC-2A	20	27	30	41	5	7	5	7
8	5/8"-11NC-2A	25	34	55	75	10	14	5	7

Notes: 1. Do not exceed Maximum Torque values listed.
2. Tighten in increments noted until required torque levels are reached.
3. Torque requirements shown are for standard B7 studs and 2H nuts.

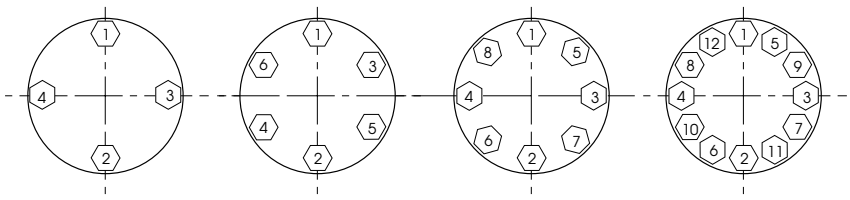

Figure 11 - Bolting Torques and Tightening Sequence

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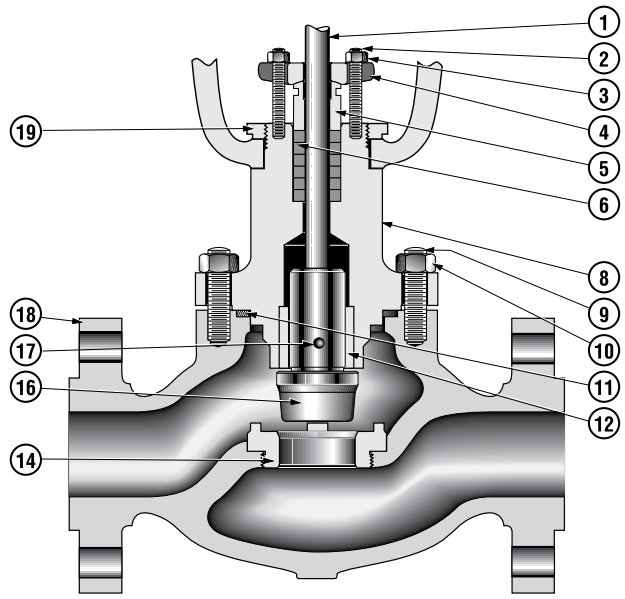

Figure 12
Threaded Seat Ring - Contoured Plug - Full Capacity

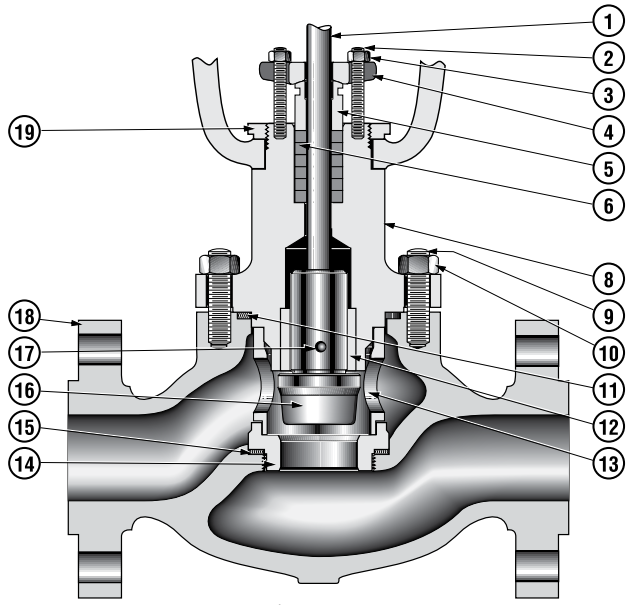

Figure 13
Quick Change Trim - Contoured Plug - Full Capacity

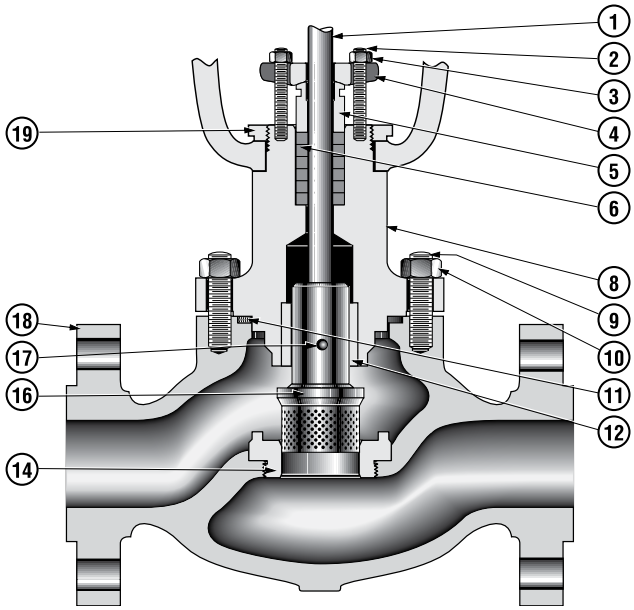

Figure 14
Threaded Seat Ring - Lo-dB Plug

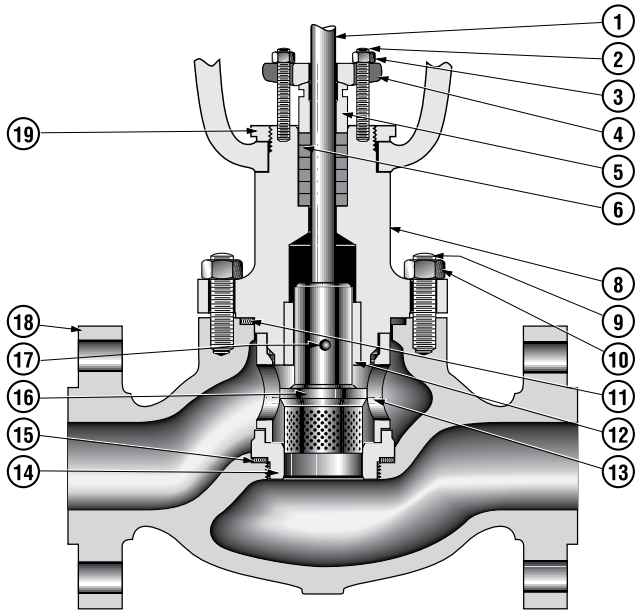

Figure 15
Quick Change Trim - Lo-dB Plug

PARTS REFERENCE

Ref.	Part Name	Ref.	Part Name	Ref.	Part Name
● 1	Plug Stem	9	Body Stud	●17	Plug Pin
2	Packing Flange Stud	10	Body Stud Nut	18	Body
3	Packing Flange Stud Nut	●11	Body Gasket	19	Drive Nut
4	Packing Flange	12	Plug Guide Bushing (Incl. w/ref. 8)		
5	Packing Follower	●13	Cage *		
● 6	Packing	●14	Seat Ring		
7	Lantern Ring (optional)	●15	Seat Ring Gasket *		
8	Bonnet	●16	Plug		

● Recommended spare parts ✶ Only on Quick Change Trim

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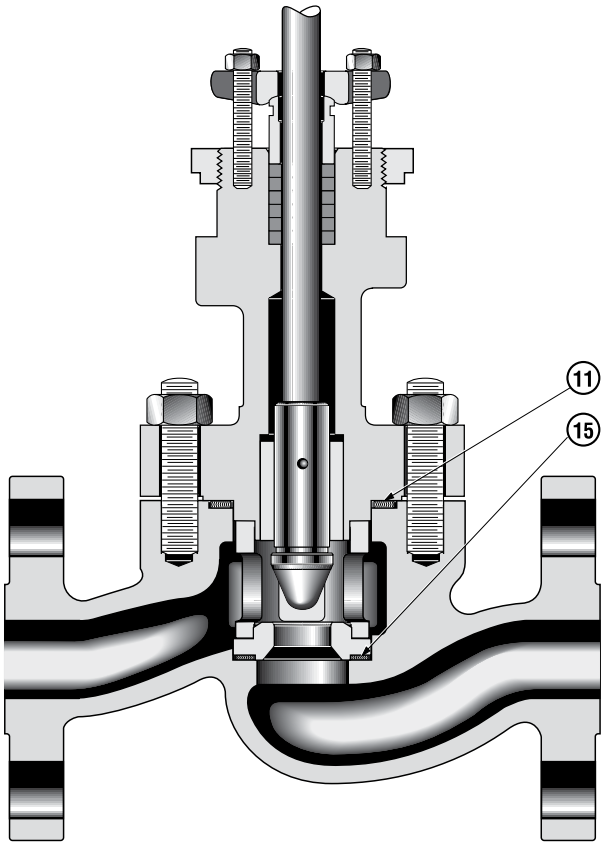

Figure 16 - 21000 Series
3/4" to 2" Valve Sizes ANSI Class 900 to 2500

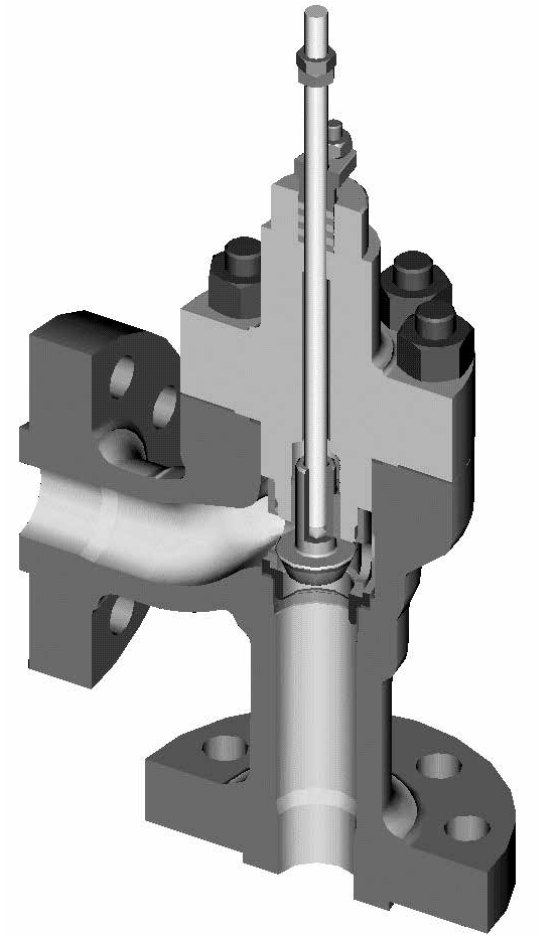

Figure 17 - Angle Body Design
3/4" to 6" Valve Sizes ANSI Class 150 to 600
3/4" to 2" Valve Sizes ANSI Class 900 to 2500

10.1 Bellows Valve Disassembly (Figure 19)

Note: *Spiral wound gaskets are standard in the 21000 BS Series design. IT IS RECOMMENDED THAT NEW GASKETS ARE INSTALLED EACH TIME THE VALVE IS DISASSEMBLED.*

10.1.1 Threaded Trim

After removing the actuator, disassemble the body S/A using the following procedure:

- Disconnect the leak-off circuit from the bonnet (if this option is included). Remove nuts (27) and bonnet studs (26) from the bonnet (25).
- Remove packing flange stud nuts (3), packing flange (4) and packing follower (5). Remove bonnet (25).
- Remove existing packing (6).
- Remove body stud nuts (10).
- Remove bonnet extension (29), stem bellows S/A (30) and plug (16) at the same time.
- Remove the plug pin (17), then remove the plug (16) from the plug stem (30). (See section 10.2.1.1 for unpinning the plug stem).
- Remove stem bellows S/A (30) by the top of the bonnet extension (29). If necessary, disengage the upper bushing of assembly (30) using a screwdriver in the groove provided for this purpose.

CAUTION

Be careful not to damage the seating surfaces of the bellows bushing.

- Remove the bonnet and spacer gaskets (28) and the body gasket (11).
- Bonnet extension (29), plug (16), guide bushings and seat ring (14) may now be inspected for wear and service damage. After determining the maintenance required, proceed to the appropriate section of these instructions.

10.1.2 Quick-Change Trim

Removal of the quick-change trim is accomplished using the same procedures as removal of the threaded trim.

However, after the bonnet extension (29) has been removed from the body, remove the cage (13), the seat ring (14) and the seat ring gasket (15).

10.2 Repair

The purpose of this section is to provide recommended maintenance and repair procedures. These procedures assume the availability of standard shop tools and equipment.

10.2.1 Plug/Stem Bellows/Bonnet Extension S/A

Plug stem pinning in the field may be required for:

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- Replacing existing plug and stem-bellows S/A
- Replacing stem-bellows S/A only

If the plug needs replacing, the stem-bellows sub-assembly should be replaced at the same time.

The original pin hole in a stem which is being reused sometimes prevents a satisfactory result being obtained and can also weaken the plug-stem assembly.

If the stem-bellows sub-assembly is being replaced, the new assembly can be fitted on an existing plug as long as it is ***in good condition and the removal of the pin has not deformed the hole or damaged it in any other way.***

Note: *Always use soft metal vise jaws to hold the plug guide surface. Failure to take this precaution could result in damage to the plug guide surface during pinning (see Figure 18).*

Be careful not to damage the plug seating surface during pin removal and assembly operations.

10.2.1.1 Unpinning the Plug Stem

- Pull and hold the plug (16) out of the bonnet extension (29) to allow access to the plug pin (17). Place the plug guide on a V-block.

  Note: *A lower mechanical stop has been provided to prevent damage of the bellows during this step.*

- Using a drift punch, drive out the existing pin (17).

  Note: *If it is necessary to drill out the pin, use a drill bit slightly smaller than the pin diameter. Be careful not to damage the hole of the plug guide.*

- Lock two nuts against each other on the end of the plug stem, and use a flat spanner on the lower nut **to prevent rotation** while unscrewing the plug from the stem. The plug is removed by turning it counter-clockwise.
- Remove the two nuts from the plug stem. Complete step 10.1.1.
- Inspect the parts and carry out any necessary repairs, then reassemble the stem-bellows sub-assembly (30) through the upper hole in the bonnet extension (29) (see section 10.2.1.2).

10.2.1.2 Mounting of the Plug-Stem/Bellows S/A into the Bonnet Extension

- Clean all contact surfaces of the bonnet extension (29) and the plug-stem/bellows S/A.
- Assemble a new gasket (28) on the upper flange of the bonnet extension.
- Insert the new stem-bellows S/A through the top hole into the bonnet extension (29).
- Pin the plug on the stem (See section 10.2.1.3).

10.2.1.3 Plug Stem Pinning

Replacing Plug and Stem/Bellows S/A

A. Screw Stem into Plug

– Lock two nuts against each other on the end of the plug stem and use a flat spanner on the upper nut to prevent rotation of the stem-bellows S/A. Screw the plug onto the lower part of the stem while inserting the plug shank into the guide bushing (12) in the bonnet extension (29).

– Pull and hold the plug (16) out of the bonnet extension (29) to allow access to the plug pin (17).

B. Drilling the New Parts

- **If the plug is already fully drilled,**

  (typical for 440C hardened stainless steel material or solid Stellite or Equivalent), then drill the stem to the same diameter (Diameter C in Figure18) as the Plug Shank Hole.

- **If the plug guide area has a center mark,**

  Place the plug guide on a V-block and use a suitable size drill to either:

– Match the hole size in the plug, or

– Match Diameter C (see Figure 18),

– Drill through the plug-stem assembly.

- **If the plug guide area has no hole or any center mark,**

– Measure Dimension D based on the plug guide diameter and stem diameter (see Figure 18).

– Place the plug guide on a V-block, and make a center mark on the plug guide area using a center punch.

– Drill through the plug-stem assembly using a suitable size drill bit.

In all cases after drilling: Remove any burrs from the plug guide hole by making a slight chamfer.

C. Pinning the Plug-Stem Assembly

– Select the correct size pin based on the plug guide diameter and stem diameter (see Figure 18). Apply a small amount of grease on the pin and hand-assemble it into the hole in the plug.

– Press fit the pin into the hole using a hammer. Complete the pinning operation by ensuring that the pin is recessed by the same amount from both sides (see Figure 18).

Replacing Stem/Bellows S/A Only

A. Screw Stem into Plug

– Refer to paragraph A of the previous section "REPLACING PLUG AND STEM/BELLOWS S/A".

B. Drilling the New Stem

– Place the plug guide on a V-block and use a suitable size drill bit to drill the stem (use the hole in the plug as a guide).

Note: *If the hole in the plug guide has been slightly damaged while removing of the old pin, choose a drill bit and a pin with a slightly larger diameter than the normal pin.*

C. Pinning

– Select the correct size pin based on plug guide diameter and pin hole diameter. Proceed as described in Paragraph C above, taking care not to damage the plug guide area.

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Plug Guide Dia. "E"		Plug Stem Dia. "F"		Pin Hole Dia. "C"		"D"		"L"	
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
7/8	22.22	1/2	12.70	.138	3.50	1.65	42	.70	18
1 1/2	38.10	1/2	12.70	.138	3.50	2.17	55	1.25	32
2 3/8	60.32	3/4	19.05	.197	5.00	2.75	70	2.00	50
2 3/4	69.85	3/4	19.05	.197	5.00	2.75	70	2.00	50

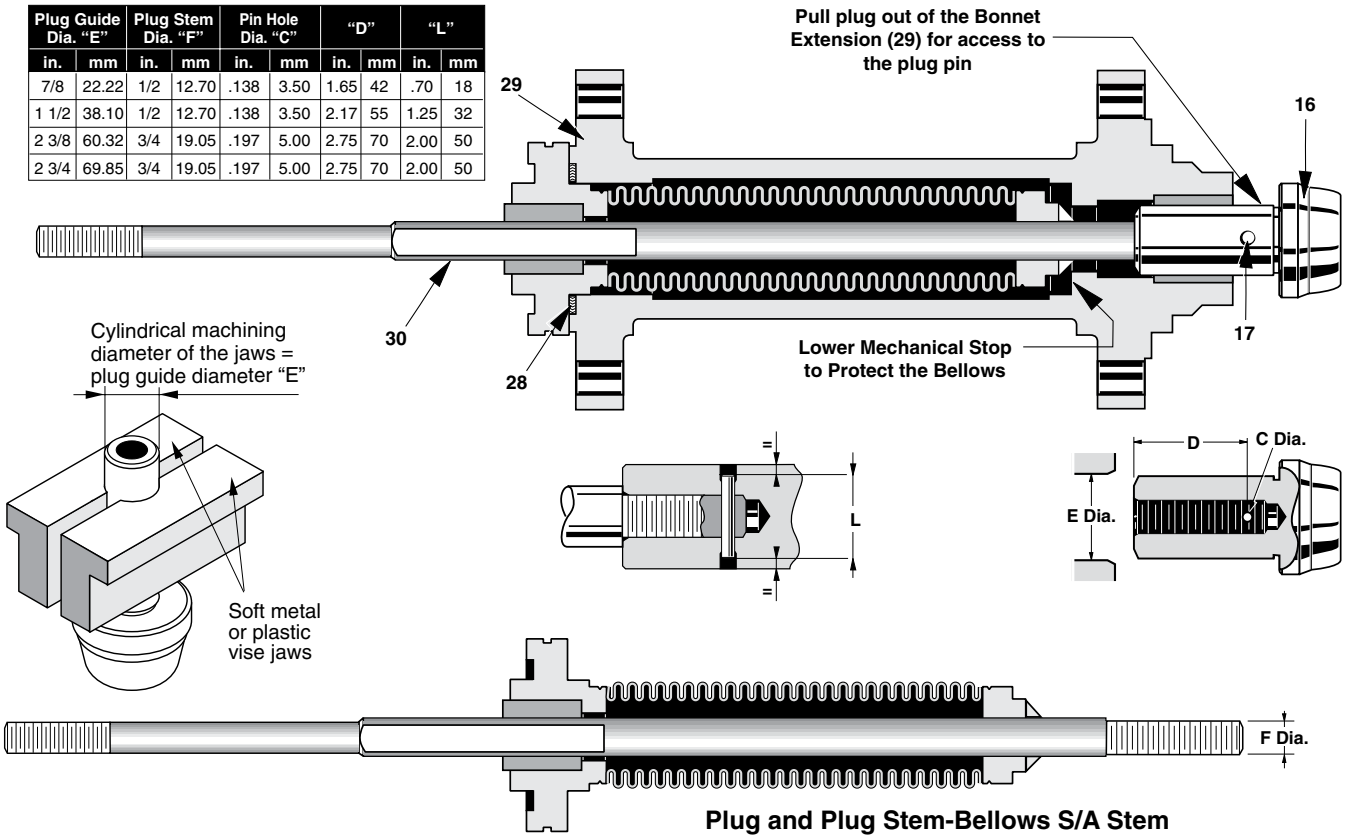

Figure 18 - Unpinning and Pinning of the Plug to Stem

10.3 Plug and Seat Ring Seating Surfaces

It is not possible to lap the plug and seat ring seating surfaces after the bellows has been assembled to the stem.

If the seat ring shows signs of minor wear, it should be turned on a lathe to clean up the worn area. The seating surface of the seat ring is 30 degrees from centerline axis. However, no more than 0.010 in. (0.25 mm) of material should be removed.

In cases where the seat ring cannot be repaired, or if the plug is also damaged the only alternative is to replace both parts.

10.4 Bonnet Reassembly

Place new gasket (28) into the groove of the bonnet spacer. Install the bonnet (25) and assemble nuts (27) and studs (26). Bonnet must be positioned so the packing flange studs are at a 90° angle to the flow centerline.

Refer to table in Figure 11 for proper bolt torque and tightening sequence.

10.5 Valve Body Reassembly

Refer to instructions stated in Section 8 for the specific trim type involved.

10.6 Actuator to Body S/A and Plug Stem Adjustment

Refer to instruction Ref. GEA19530.

WARNING

Assembly of the No. 6 actuator on a bellows seal valve requires a three-sectioned coupling. Follow coupling instructions as described for the No. 10, 16 and 23 actuators.

CAUTION

The bellows assembly causes a "spring back" effect. Measure this plug spring back before referring to Instruction Ref. GEA19530. Be sure to add this spring back length to the over seat adjustment.

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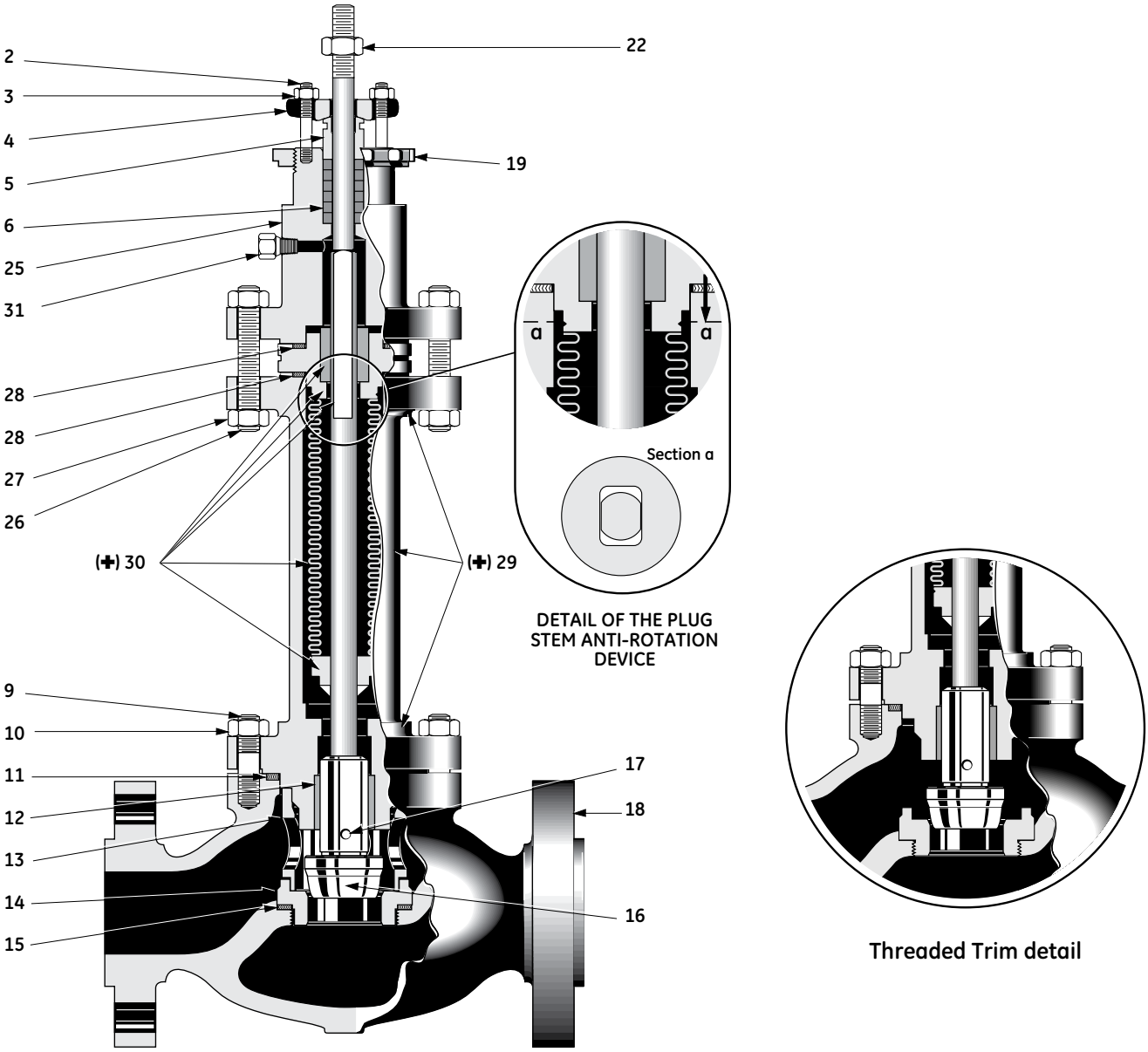

Figure 19 — 21000 BS Valve

PARTS REFERENCE

Ref.	Part Name	Ref.	Part Name	Ref.	Part Name
● 1	Plug Stem	■ 15	Seat Ring Gasket	+	Spacer
2	Packing Flange Stud.	● 16	Plug	+	Lower Flange
3	Packing Flange Nut	● 17	Plug Pin	30	Bellow and Stem Assembly
4	Packing Flange	18	Valve Body	+	Stem
5	Packing Follower	19	Drive Nut		Guide Bushing
● 6	Packing	22	Plug Stem Locknut	+	Bellows
9	Body Stud	25	Valve Bonnet	+	Upper Adapter (Bellows)
10	Body Stud Nut	26	Bonnet Stud	+	Lower Adapter (Bellows)
● 11	Body Gasket	27	Bonnet Stud Nut	31	1/8" NPT Plug
12	Guide Bushing	● 28	Bonnet Spacer Gasket		
■ 13	Cage	29	Bonnet Extension Assembly		
● 14	Seat Ring	+	Upper Flange		

● Recommended Spare Parts + These parts included in welded subassembly ■ Quick change trim only

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